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UNMANNED CONSTRUCTION SYSTEM FOR DISASTER RESPONSE

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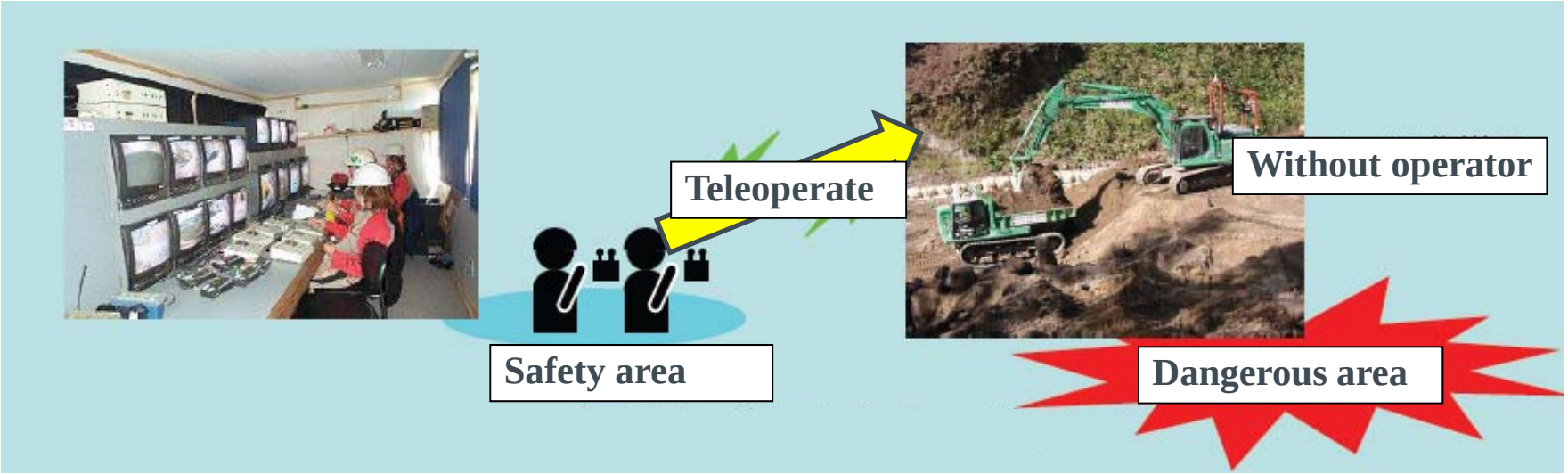
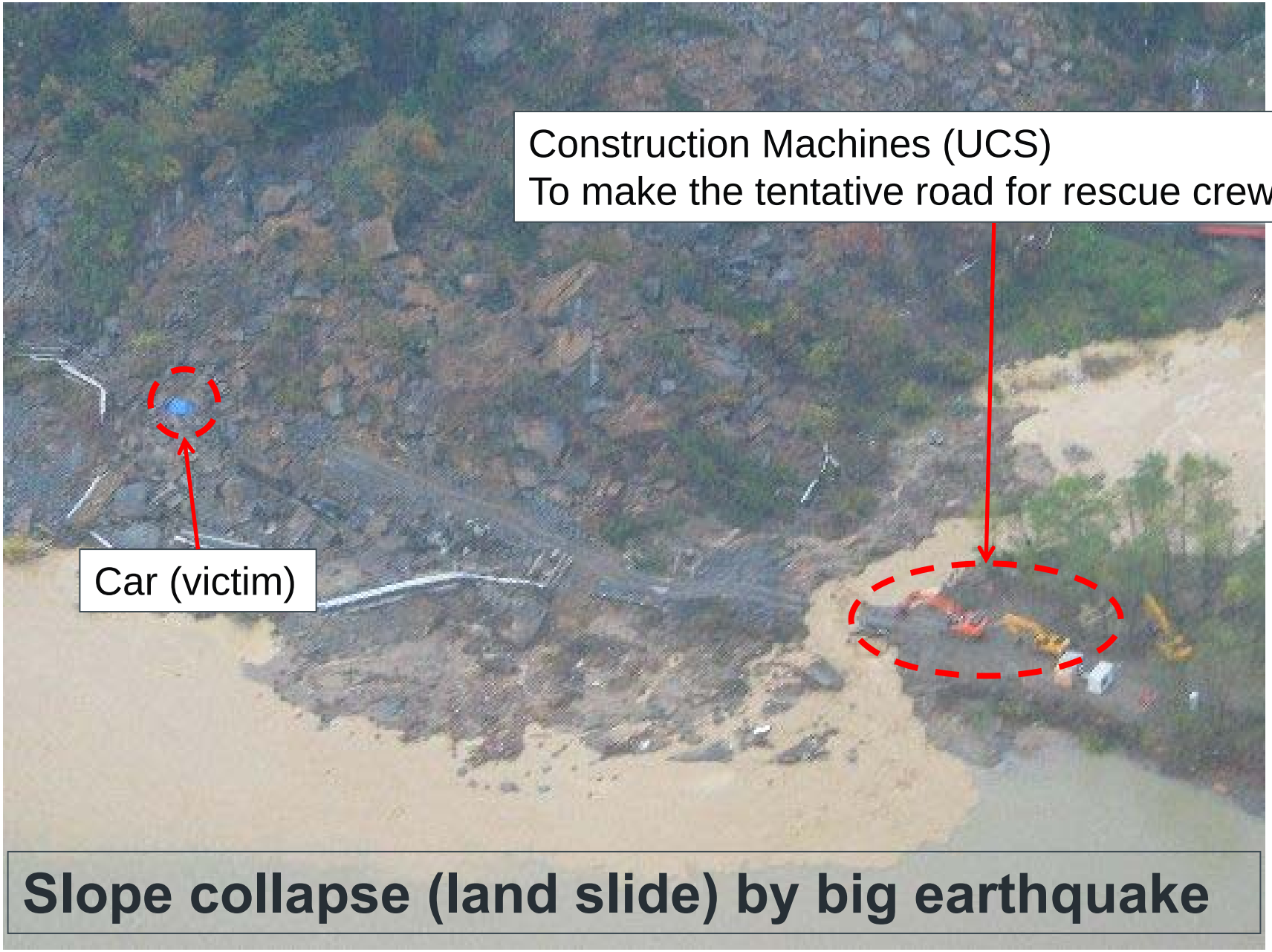
What is “Unmanned Construction System” ?



Construction system using
teleoperated construction machine

To reduce risk of accidents in dangerous areas

For example….1.



For example….2.

Types of UCS

(UCS has two types)

1. Direct viewing system

Distance (between operator and machine)
～app.30m

Photo By Kumagai-gumi

2. Non-Direct viewing system

Distance
over 100m

Camera carrier

Dangerous area

Machines

Relay station car

For big projects

Remote operation room

Photo By Kumagai-gumi

2. Non-Direct viewing system

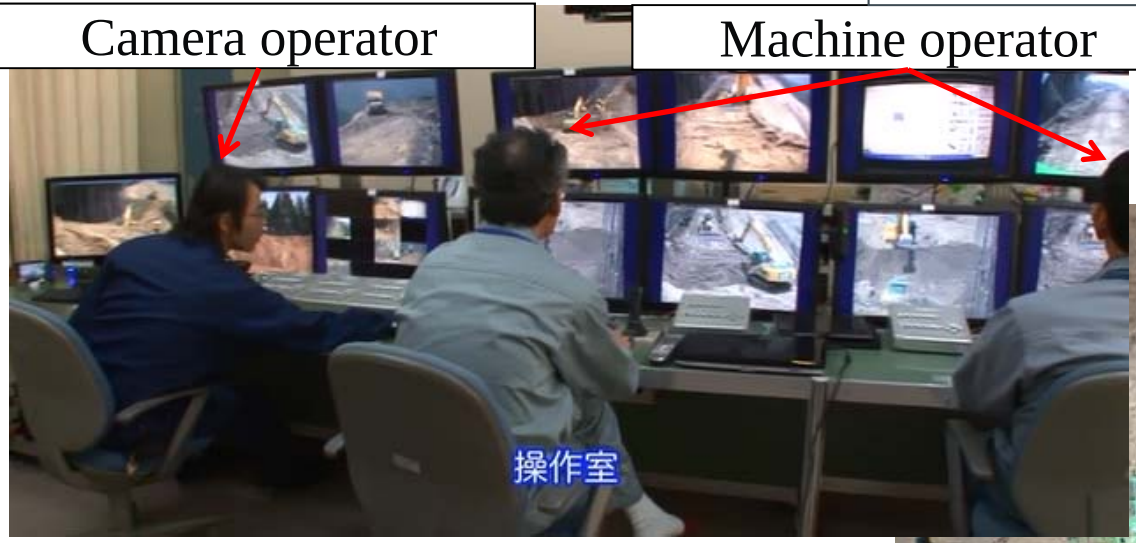
Machine operators use some monitors
(from camera carrier and operator's seat)

Camera operator control the monitors for machine operators
(Pan, Tilt, Zoom, Change)

"The position of camera carrier" and "The skill of camera controller" are very important !!

Camera operator

Machine operator



Camera carrier

This is a unique and innovative system developed in Japan.

Developed and progressed through the Unzen Project

Photo By Kumagai-gumi

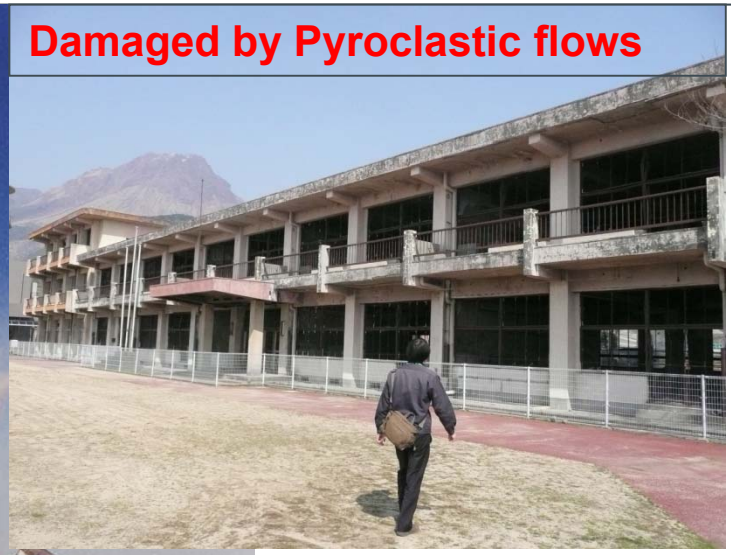
Unzen Project

Mt. Unzen-Fugen
Active volcano in Kyushu, Japan

By Unzen Restoration Project Office

Unzen Project

Mt. Unzen-Fugen
Active volcano in Kyushu, Japan

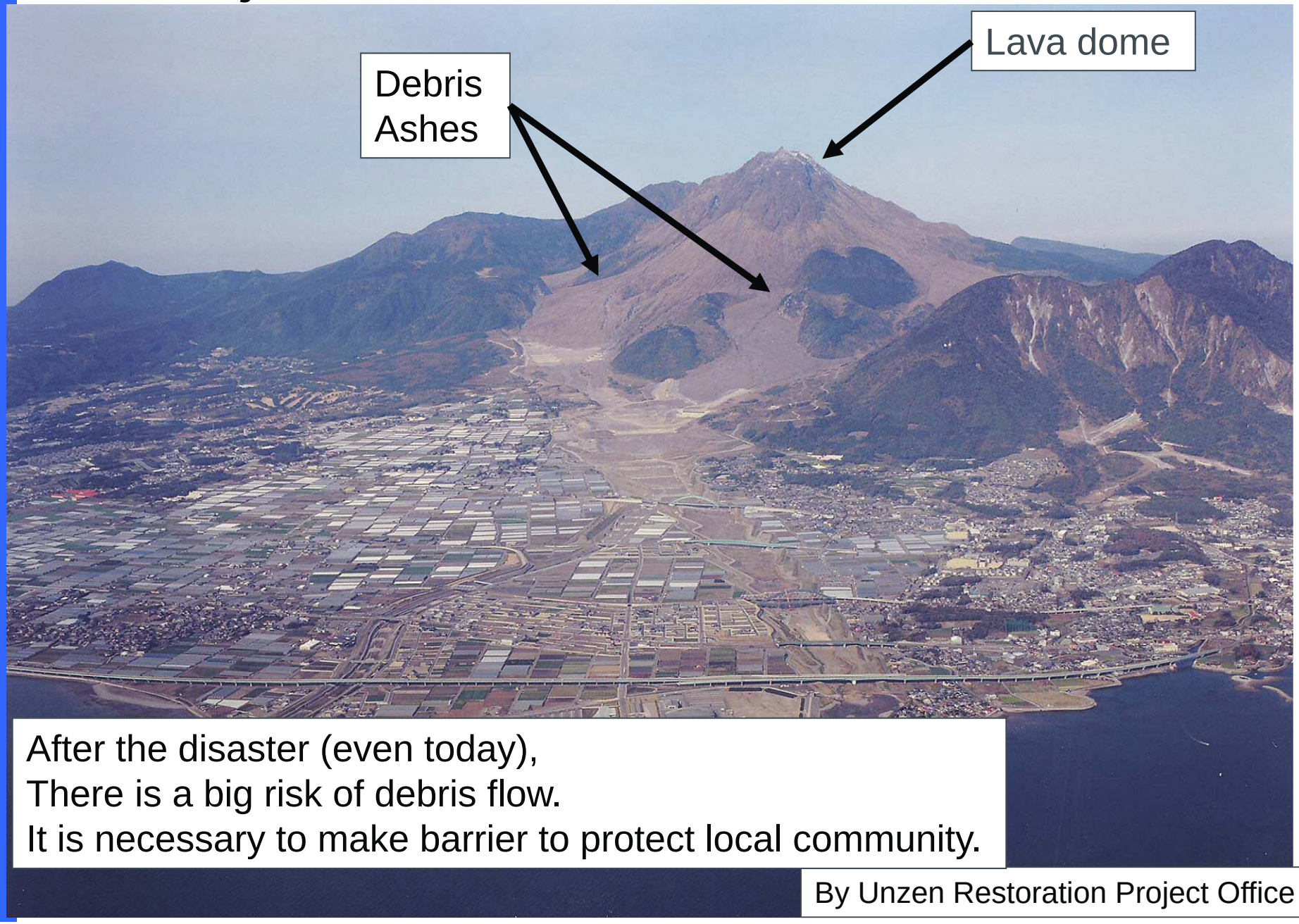


[Damage]

41 dead, 3 missing, 12 wounded, 2,511 buildings damaged, 229.9 billion JPY of damage
62 debris flows, total sediment discharge of ca. 7.6 million m^3, and 9,432 pyroclastic flows

By Unzen Restoration Project Office

Unzen Project



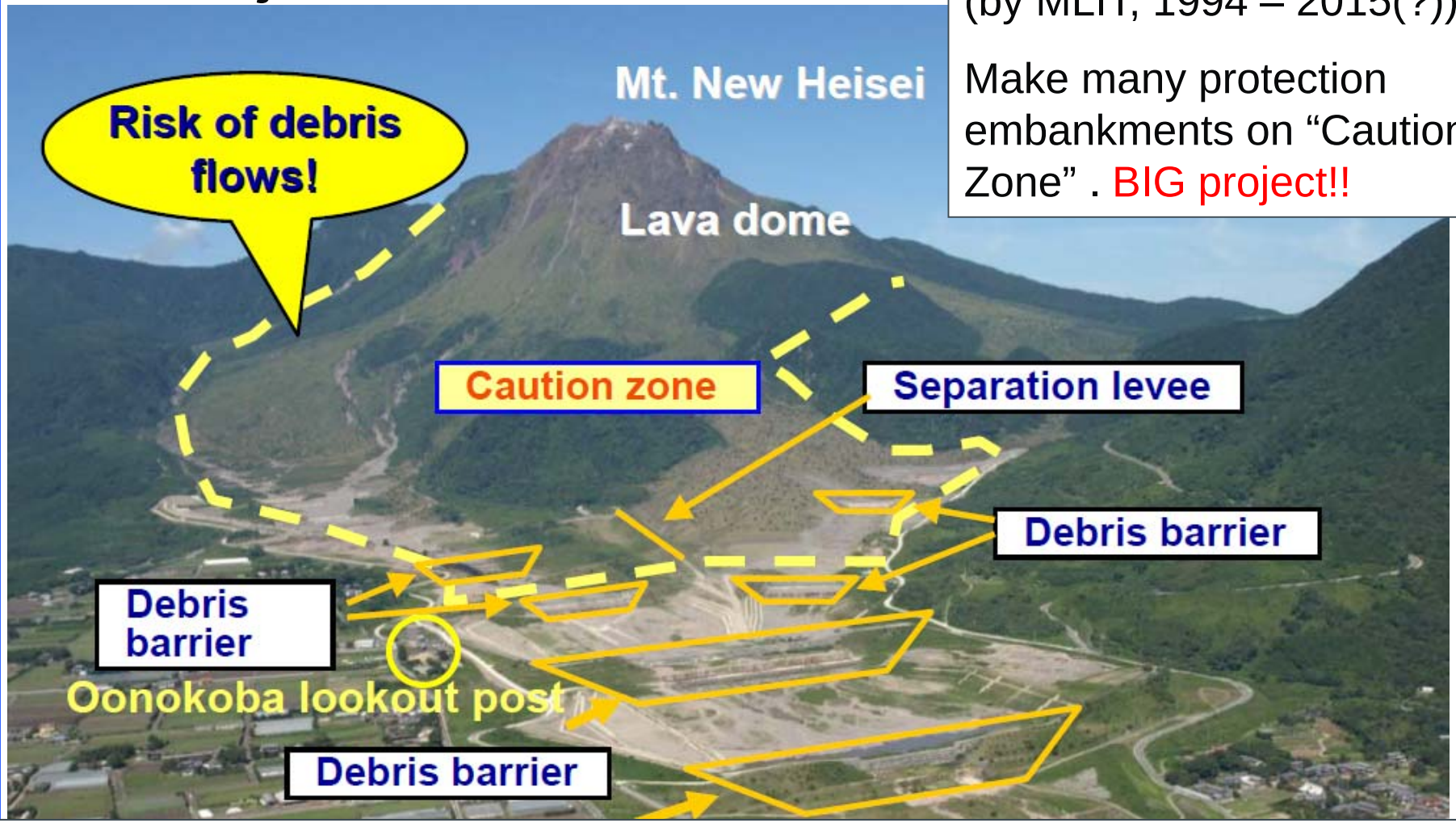
After the disaster (even today),
There is a big risk of debris flow.
It is necessary to make barrier to protect local community.

By Unzen Restoration Project Office

Unzen Project

Unzen Restoration Project (by MLIT, 1994 – 2015(?))

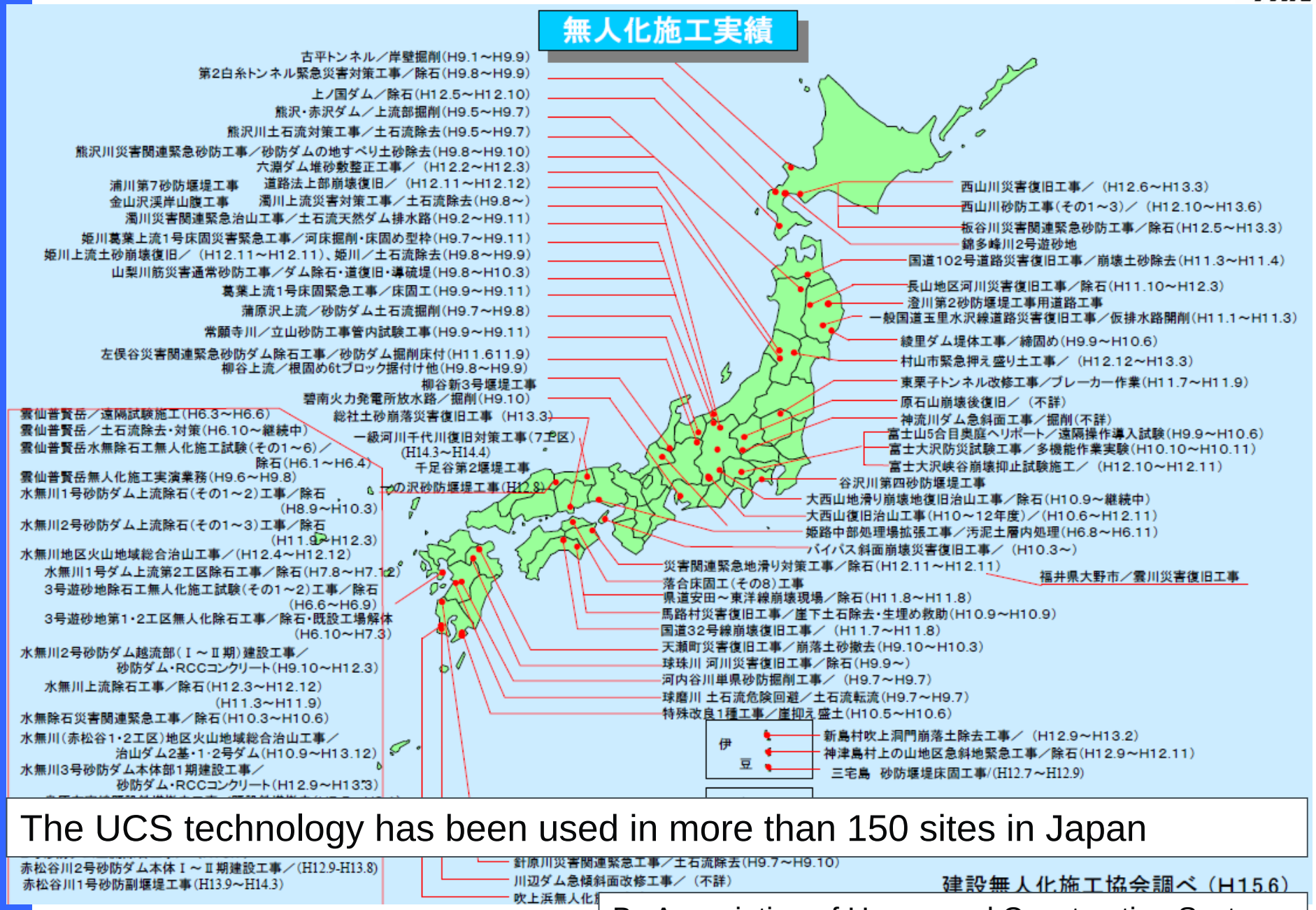
Make many protection embankments on “Caution Zone” . BIG project!!



UCS was developed for this project.
They use this project like “Trial field” and “Training field” for UCS.

Through this project, the UCS was progressed to "general teleoperated construction technology".

By Unzen Restoration Project Office



The UCS technology has been used in more than 150 sites in Japan

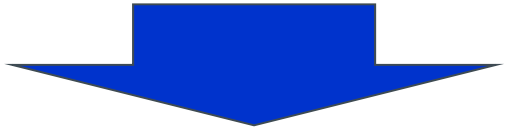
By Association of Unmanned Construction System

Lessons Learned

1. In our experience, the longest distance between operator and machine is over 80km. (Fiber-optic cable + Wireless LAN)
   ⇨ It is possible to control on longer distance.
2. If the delay time of video is less than 0.5sec, the operator does not feel stress. (where the delay time must be constant.)
3. “The position of camera carrier” and “The skill of camera controller” are very important for this system.
4. Regarding Wireless Communication,
   High frequency signal has advantage on capacity and speed.
   Low frequency signal has advantage on diffraction.
   ⇨ It is important to choose appropriate frequency.

Problems on UCS

1. Low-work-efficiency (app. 50%)
2. Operators, having a good skill for UCS, are very few.
   (app.30 in Japan)
   (Good operator for normal work is not always good operator for UCS)
3. Unzen project (main work) will finish next year.
   It is necessary to build other “Trial and Training field”.



To solve these problems,

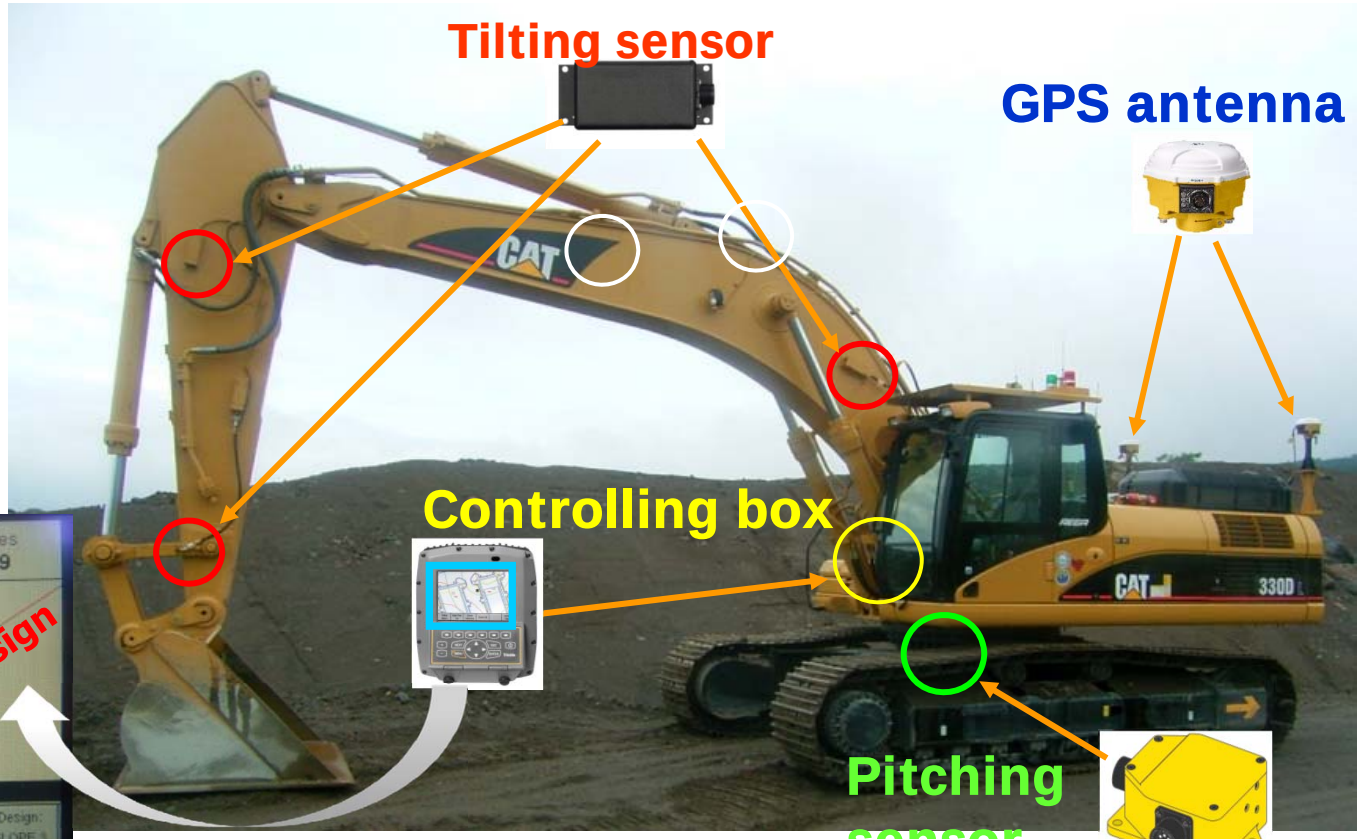
- Some future technologies are developing
  - Machine Guidance System
  - Realistic operating room
- Discussion for establishment of “DISASTER RESPONSE CENTOR” was started.

Solution to improve efficiency

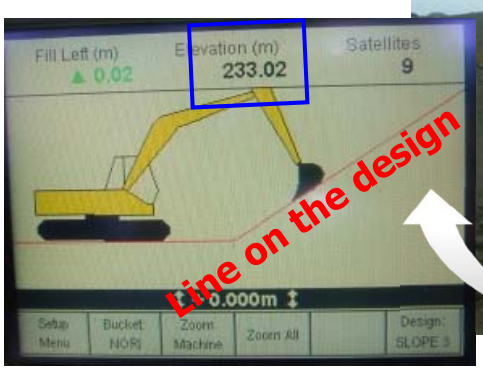
1.Machine Guidance system

(Photo By Kumagai-gumi)

Guide the distance between bucket and designed line



Distance to the designated line



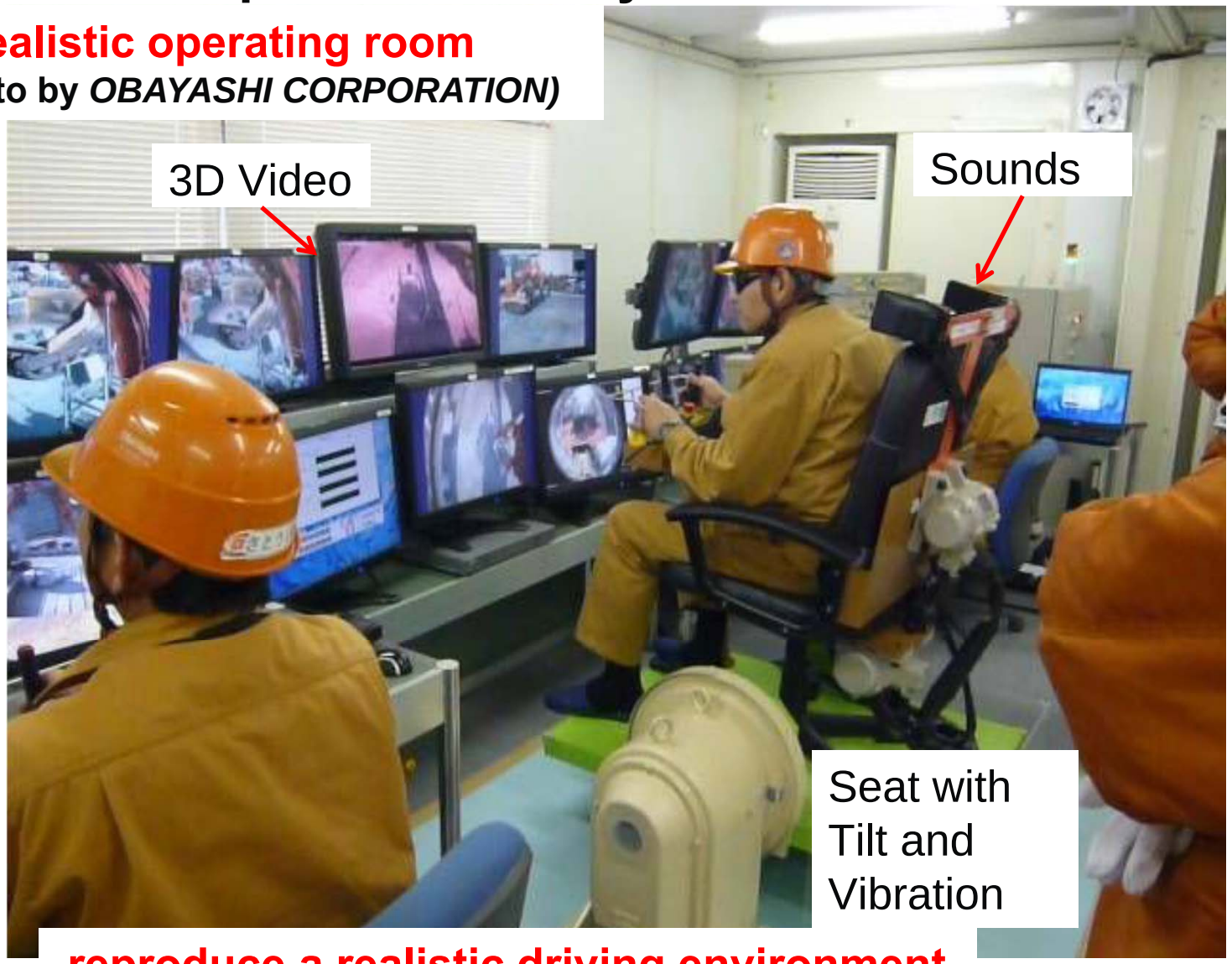
Visual data on the working form

Result : efficiency 50%→60%

Solution to improve efficiency

2.Realistic operating room

(Photo by *OBAYASHI CORPORATION*)



reproduce a realistic driving environment

On the verification now

Solution to keep operator's skill and machines

It is necessary to organize "DISASTER RESPONSE CENTOR"
(Suggestion from COCN : Council on Competitiveness-Nippon)
as a "Training center for operator"
"Trial field for new technology"
In place of UNZEN Project.

It is important to keep operator's skill and special machines for next disaster.
Nobody know when the next disaster strike us!!
This center will be great help for quick response!!

Conclusion

1. Unmanned Construction System (UCS) is the one of the effective solution for disaster response.
2. UCS was developed and progressed through the Unzen Project.
3. Unzen project is the “Trial field” and “Training field” for UCS technology.
4. Unzen Project will be finished next year.
   It is necessary to build other “Trial and Training field”.
5. Efficiency of UCS is lower than normal operation (about 50%).
   We need revolutionary new technology.
   Do you have any idea??